Rec.Models.Rockets FAQ (Frequently Asked Questions)

Part 10: High Power Rocketry

Posted: November 17, 1998

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Review: A High Power rocket is a model weighing more than 1500 grams (3.3 lb) or containing more than 125 grams of propellant or containing any motor with more than 62.5 grams of propellant.

10.1 I'm a successful model rocketeer. What do I need to get into HPR?

When this question was posted to r.m.r a while back, these were the predominant suggestions and tips:

- Start with E/F/G kits with 29mm motor mounts from Estes/NCR, LOC or Aerotech. These should be the easiest to build.
- Read and become familiar with the NAR and/or Tripoli High Power Safety Code(s)
- Get familiar with and use expendable motors before jumping into reloadable technology.
- Join a high power club if possible (local NAR section or Tripoli prefecture).
- Be very careful of the construction differences between model and high power rockets. You HAVE to build higher power rockets to be more sturdy than model rockets (see the next question).
- If not already a member, join both the NAR and Tripoli (if you can afford high power rocketry, you can afford to join and support both these organizations).

10.2 What are the major differences between model and high power rockets, besides size and engines? Are they built differently?

Above and beyond all else, high power rockets are built much stronger than standard model rockets. This is due to the higher speeds and acceleration achieved by these models. Some of the construction differences are:

- High power rockets have stronger, thicker body tubes
- They have MUCH stronger engine mounts, bonded using epoxy rather than white or yellow glue
- Engine mount rings, adapter rings, etc., are typically made from 1/8" or thicker aircraft plywood, fiberglass, or phenolic sheet, rather than paper or balsa.
- Fins are typically made from plywood, fiberglass, phenolic, or waferglass, not balsa; Thick balsa fins have been used on H/I powered models, but they have to be reinforced with fiberglass/epoxy laminate.
- Fins are often mounted into slots in the body tube with Through The Wall (TTW) mounting. Most common and recommended method is glued TTW and directly onto the motor tube.
- Parachutes are larger and typically made from some type of fabric (plastic chutes are not strong enough, usually)
- Heavy elastic shock cords with steel braid or Kevlar shock line are used rather than rubber for shock cords, and these are typically epoxied to the motor mount or a bulkhead
- Positive motor retension systems (clips, bolts, etc.) are important, as HPR reload casings start to get pretty expensive

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10.3 How do I get high power certified?

There are two organizations which may certify you to purchase and use high power rocket motors. These are the National Association of Rocketry and the Tripoli Rocketry Association. Note that you must be a member of the organization to certify for high power with that organization. Once certified, both organizations recognize the certification of the other, but this may change in the future.

As of April, 1996, new NAR certification procedures have gone into effect.

Current NAR procedures:

- For Level 1 certification (the first step) one must fly an H or I powered rocket successfully, and have it witnessed by two senior NAR members, one of which must be high power certified. Fill out the proper form, have it signed by the witnesses, and send it in to NAR HQ.

  NOTE: NFPA 1127 allows an uncertified individual to purchase a single H or I motor for certification purposes.

- For Level 2 certification (the next step up) one must take and pass a

written exam, and then successfully fly a J/K/L powered rocket.
Questions for the examination come from a pool of questions that are
available for review prior to taking the test.

- The NAR does not currently certify to Level 3 (M and up).

Tripoli certification procedures are scheduled to change on 1 Sep 1996.
At that time there will be three (3) high power certification levels:

- Level 1, allowing single motor H and I flights. No clusters or staging.
- Level II, allowing up through L motors, staging, clustering and hybrids.
- Level III, unlimited, allowing M power and up.

A written test will be required for Level II certification, in addition to
the certification flight. Level III certification requirements will require
pre-flight approval and review from the Tripoli Advisory Board.

10.4 What is a 'reloadable' motor. Are they worth the price? Are they legal?

A reloadable rocket motor is a metal cylinder with screw-on end pieces.
Solid propellant and time delay are purchased separately from the motor
casing, in 'reload kits'. These kits contain all of the expendable,
non-reusable materials for a single flight. The cost of the reload is
significantly less than the cost of an expendable motor (when talking
about F sizes and up). Quite a number of reloadable motors and reload
are now certified by NAR or Tripoli. Refer to the approved motor lists of
each organization to see exactly which motors are currently certified.

YOU MUST BE A CERTIFIED MEMBER OF A QUALIFIED ORGANIZATION TO PURCHASE OR
USE RELOADABLE HIGH POWER MOTORS. See section 3.1.9, below, for
information on becoming certified to use high power reloadable motors.

WARNING: IT IS HIGHLY RECOMMENDED BY r.m.r CONSENSUS THAT YOU DO NOT ASSEMBLE AND/OR PREP A RELOADABLE-TYPE MOTOR UNTIL JUST PRIOR TO ITS USE (I.E., ON THE FLYING FIELD). * UNDER NO CIRCUMSTANCES SHOULD ASSEMBLED RELOADABLE MOTORS BE STORED WITH IGNITERS INSTALLED ***

10.5 What are these different 'types' of composite motors I hear about (White Lightning, Black Jack, Smokey Sam, etc.)?

These are all manufacturers' names for various formulations of 'stuff'
they have added to the propellants to get specific pyrotechnic effects.

Black Jack (Aerotech): low(er) average thrust engine which produces a
dense, dark exhaust to aid in tracking. Also has a distinctive roar.
Note: BJ motors have a slow thrust buildup and long ignition time. Take
care when using this type of motor in a cluster. Also play close
attention to the manufacturer's Maximum Recommended Liftoff Weight
(MRLOW).
Blue Thunder (Aerotech): high level average thrust engines with a bright
violet-blue flame and very little visible exhaust. Designed for high
thrust, high acceleration lift-offs. Ignites quickly. Very fast thrust
build-up.
Firestarter (US Rockets): low impulse composite formulation which produces
large numbers of sparks.
Hellfire (Vulcan): a high thrust motor which produces a bright red
flame.
Smokey Sam (Vulcan): produces a dark exhaust to aid in tracking.
Silver Streak (Rocketflite/MRED): produces a fine shower of white sparks
during boost (these are actually black powder motors). VERY fast
ignition and thrust buildup.
White Lightning (Aerotech): medium average thrust engine producing a
bright white flame and distinctive roar. Ignites quickly. Moderately
quick thrust buildup.

10.6 What's an FAA waiver? Which rocket flights require one?

An FAA waiver is official permission by the Federal Aviation Administra-
tion allowing the launching of rockets exceeding a certain size. The rules
appear in FAR 101.
FAR 101 is on the web: http://www.faa.gov/avr/afs/fars/far-101.txt

The following are the relevant sections of FAR 101, regulating the
launching of model and high power rockets.

---------- FAR 101 Subpart A--General ----------

Sec. 101.1 Applicability.

(a) This part prescribes rules governing the operation in the United
States, of the following:
(3) Any unmanned rocket except:
(i) Aerial firework displays; and,
(ii) Model rockets:
(a) Using not more than four ounces of propellant;
(b) Using a slow-burning propellant;
(c) Made of paper, wood, or breakable plastic, containing no
substantial metal parts and weighing not more than 16 ounces,
including the propellant;
and
(d) Operated in a manner that does not create a hazard to persons,
property, or other aircraft.

[Doc. No. 1580, 28 FR 6721, June 29, 1963, as amended by Amdt. 101-1, 29 FR
46, Jan. 3, 1964; Amdt. 101-3, 35 FR 8213, May 26, 1970]

Sec. 101.3 Waivers.

No person may conduct operations that require a deviation from this part except under a certificate of waiver issued by the Administrator.

[Doc. No. 1580, 28 FR 6721, June 29, 1963]

Sec. 101.5 Operations in prohibited or restricted areas.

No person may operate a moored balloon, kite, unmanned rocket, or unmanned free balloon in a prohibited or restricted area unless he has permission from the using or controlling agency, as appropriate.

[Amdt. 101-1, 29 FR 46, Jan. 3, 1964]

Sec. 101.7 Hazardous operations.

(a) No person may operate any moored balloon, kite, unmanned rocket, or unmanned free balloon in a manner that creates a hazard to other persons, or their property.
(b) No person operating any moored balloon, kite, unmanned rocket, or unmanned free balloon may allow an object to be dropped therefrom, if such action creates a hazard to other persons or their property.

(Sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)))

[Doc. No. 12800, Amdt. 101-4, 39 FR 22252, June 21, 1974]

---------- FAR 101, Subpart C--Unmanned Rockets ----------

Source: Docket No. 1580, 28 FR 6722, June 29, 1963, unless otherwise noted.

Sec. 101.21 Applicability.

This subpart applies to the operation of unmanned rockets. However, a person operating an unmanned rocket within a restricted area must comply only with Sec. 101.23(g) and with additional limitations imposed by the using or controlling agency, as appropriate.

Sec. 101.22 Special provisions for large model rockets.

Persons operating model rockets that use not more than 125 grams of propellant; that are made of paper, wood, or breakable plastic; that contain no substantial metal parts, and that weigh not more than 1,500 grams, including the propellant, need not comply with Sec. 101.23 (b), (c), (g), and (h), provided:
(a) That person complies with all provisions of Sec. 101.25; and
(b) The operation is not conducted within 5 miles of an airport runway or other landing area unless the information required in Sec. 101.25 is also provided to the manager of that airport.

[Amdt. 101-6, 59 FR 50393, Oct. 3, 1994]

Sec. 101.23 Operating limitations.

No person may operate an unmanned rocket--
(a) In a manner that creates a collision hazard with other aircraft;
(b) In controlled airspace;
(c) Within five miles of the boundary of any airport;
(d) At any altitude where clouds or obscuring phenomena of more than five-tenths coverage prevails;
(e) At any altitude where the horizontal visibility is less than five miles;
(f) Into any cloud;
(g) Within 1,500 feet of any person or property that is not associated with the operations; or
(h) Between sunset and sunrise.

(Sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)))

[Doc. No. 1580, 28 FR 6722, June 29, 1963, as amended by Amdt. 101-4, 39 FR 22252, June 21, 1974]

Sec. 101.25 Notice requirements.

No person may operate an unmanned rocket unless that person gives the following information to the FAA ATC facility nearest to the place of intended operation no less than 24 hours prior to and no more than 48 hours prior to beginning the operation:
(a) The names and addresses of the operators; except when there are multiple participants at a single event, the name and address of the person so designated as the event launch coordinator, whose duties include coordination of the required launch data estimates and coordinating the launch event;
(b) The estimated number of rockets to be operated;
(c) The estimated size and the estimated weight of each rocket; and
(d) The estimated highest altitude or flight level to which each rocket will be operated.
(e) The location of the operation.
(f) The date, time, and duration of the operation.
(g) Any other pertinent information requested by the ATC facility.

[Doc. No. 1580, 28 FR 6722, June 29, 1963, as amended by Amdt. 101-6, 59 FR 50393, Oct. 3, 1994]

10.7 OK. I want to fly some high power rockets. How do I get an FAA waiver?

A downloadable, printable copy of
Form 7711-2, Application for Certificate of Waiver, is available at:

http://www.faa.gov/avr/afs/Waiver.htm

From: jsvrc@edison.rc.rit.edu (J A Stephen Viggiano)
I'd like to share with those interested what is involved in applying for an FAA Waiver. It's not a particularly difficult procedure, and the FAA personnel I have dealt with are courteous, professional, and helpful. Don't be scared of the bureaucratic red tape, there isn't a whole lot of it.

You can get the forms from the Flight Standards District Office (the "Fizz-Doe") at any airport with air traffic control. Phone the tower and ask for Flight Standards. Tell them you're interested in launching rockets, and need an Application for Waiver, FAA Form 7711-2. They should know what you want. While you've got them on the phone, ask for the address of the Regional office. You will probably have to file your application with them, so it will help to know where it has to go!

Now, you take a field trip. Get in your car, and drive to the airport. Not the passenger terminal, the part where all the private general aviation planes are parked. There should be a place there for pilots to pay for fuel, buy toothbrushes and other sundry items, including section maps. Ask them for the map which includes your launch site. If you're not near a section boundary, it should be the same map which includes the airport. (It will also be the most popular map there, and they may be out of stock.)-: We're covered by the Detroit section map, for example. Never mind that it's a few states away, and New York is closer, that's just the way they carve things up. It costs about $3, and it's fun to look at and try to decipher.

Locate your launch site on the section map. Are there any airports within 5 miles? If so, you'll need a waiver of Section 101.23(c), which addresses your proximity to an airport, in addition to waiver of Section 101.23(b), which covers controlled airspace. You type these section numbers on line 4 of the application. Lines 1, 2, and 3 are your name, address, telephone number, and all that David Copperfield crap, as Salinger called it.

Line 5 asks for a detailed description of what you want to do. I usually put something like the following:

> Normal operations of Model and High Impulse Rockets
> weighing more than 16 ounces (but less than 80 ounces)
> in accordance with the National Association of Rocketry
> Safety Codes (please see attached).

Line 6 asks for the location. If you've got the lattitude and longitude to the second, use them. Otherwise, you can refer to a copy of the portion section map, like this:

> On the grounds of and directly above the National Warplane
> Museum, Geneseo, NY (please see attached portion of Detroit
> section map).

You can then copy that portion of the section map, circle the launch site in red or some other color, and write the legend, "Area of Proposed Operations." (Remember, these folks talk in Bureaucratese.)

In either case, this is the line on which you request altitude. Again, in FAA patois, "No operation under this waiver will exceed 5000 feet AGL" are the magic words which have worked for us (along with "please" and "thank you"). If you can read the altitude of the terrain on the section map, you can add this to the requested altitude above ground level to arrive at the altitude above Mean Sea Level (MSL), which might be appreciated by the person processing your application.

On Line 7 you give your starting and ending dates and times, and any rain dates. It's not necessary (nor is it desirable) to use Zulu (Greenwich Mean) Time, but these folks use that "hundred hour" jazz that Colonel Blake on M*A*S*H hated so much. Make sure to indicate what time zone you're referencing, for example "1030 EDT".

Lines 8 through 14 pertain to airshows and the like, so just put an "N/A" or two there to let them know these areas aren't blank because of an omission. You sign on Line 15, and have an opportunity to say a little something about how you're going to be running things. I usually write in the following, under "Remarks":

> All operations will be conducted in accordance with the NAR
> Safety Codes and shall be under the control of an experienced
> Range Safety / Launch Control Officer. A spotter will watch
> for aircraft entering the operations area, and will temporarily
> suspend operations in this contingency.

Make three copies. Keep one for yourself, send your original and two of the copies to the Regional Office. Attach three copies of both Safety Codes, because the Model Rocket Safety Code covers rockets which will be under the terms of the waiver. Also attach three copies of the germane portion of the section map, if that's how you're indicating where you are going to fly. Include a short letter of transmittal.

After having some scares about the last two applications I sent in, next time I plan to include a receipt postcard. I'm going to put my address on the address side, and on the other side it will say:

> Received _____ (date) an Application for
> Certificate of Waiver or Authorization, FAA Form
> 7711-2, at this office. For further information,
> please contact _____ (name) at
> _____ (telephone number, extension).

Bureaucrats see these things all the time, and they know what to do with them.

Mail off this packet to the FAA Regional Office, to the attention of Flight Standards (I think!). You need to apply at least 30 days (the form says 45 days, so be sure) in advance. If you don't hear back from them in two or three weeks, give them a call. We had to do this twice; once the form was lost, and another time it was just in the "in" basket.

If all goes according to plan, you should get back your application, all the other stuff you sent (talk about carrying coals to Newcastle!), and the Magic Certificate of Waiver! There will be a few strings attached. You should be instructed to inform the nearest ATC, and possibly an Automated Flight Information Service, a certain time before you start, in order to "activate" your waiver. You'll probably be instructed to contact them when you're done, too. Usually these things are not a big deal, but sometimes you get a person who doesn't know why you're bothering them. Just tell them that you're carrying out instructions from the Regional Office to give a Notice to Airmen, pursuant to the terms of your Certificate of Waiver. A little official-sounding talk will make them feel right at home.

Of course, you have to make sure all fliers are familiar with the terms and conditions of your waiver, because it's your butt that's on the line, too. It is a standing MARS policy that the waiver certificate and application are available for inspection by all fliers.

After the launch, I usually send a letter to the person who sent me the Certificate of Waiver, thanking them for their help, and letting them know we had a safe and enjoyable time. It helps grease the skids for the next waiver you want, besides being common courtesy.

It's not hard to obtain a waiver if you make your application in a professional manner, and conduct your activities likewise. There's no fee, but there is some effort involved. Finally, keep in mind that the people working on your application are people, and as such they respond to being treated courteously and professionally. I hope you find the process relatively simple and painless.

10.8 Is high power rocketry legal in every state, if the proper forms are obtained?

No. Even with an FAA waiver, HPR is NOT legal in every state. Check with your local fire marshal for requirements/restrictions in your area. The NAR and Tripoli are actively working to get state restrictions on model and HPR removed.

10.9 Where do I find out the proper way to use HPR rockets and motors? I'm familiar with the NAR Model Rocketry Sporting Code. Is there an HPR equivalent?

Both the NAR and Tripoli have HPR safety codes. The two organizations are working together to produce a consistent safety code to be presented to the NFPA. These codes specify minimum launch field sizes, minimum distance to keep from launchers, etc. The NAR High Power Rocket Safety Code has been published in Sport Rocketry, and is on their web site. The Tripoli safety code is published in their Members handbook, which is sent to all new Tripoli members.

EVERYONE WANTING TO GET INVOLVED IN HPR IS STRONGLY URGED TO JOIN ONE OR BOTH OF THESE ORGANIZATIONS. There are legal restrictions to buying high power motors. Only certified members of 'legally qualified' organizations may purchase them. If you want to fly high power you need to be a member of either the NAR or Tripoli.

The High Power Safety Codes for both the NAR and Tripoli are based on the NFPA 1127 guidelines. Both organizations recognize the others safety code, motor certifications, and HPR user certifications.

10.10 What are some good kits to build when first getting into high power rocketry (assuming I have all of the basic model rocketry skills)?

Popular rec.models.rockets vote:
LOC Graduator

From: cdt@pdp.sw.stratus.com (C. D. Tavares)
AAA Penn. Crude

From: kaplowro@hccompare.com (Bob Kaplow)
- Avoid any kit with plastic fins or internal parts.
- Avoid phenolic tubes, thick cardboard tubes are more familiar and easy to work with
- For Large Model Rockets, try a LOC Graduator or Rocket R&D/THOY Hornet
- For a High Power rocket try a LOC IV or EZI-65, or a Rocket R&D/THOY Falcon

From: JCook@Epoch.C (Jim Cook):
LOC kits are a good introduction into high power - they are strong (banging it several times for emphasis on the table).

From: bmcdermo@ix.netcom.com (Buzz McDermott)
If you have never flown anything bigger than an Estes or FSI D motor, I would recommend building one or more E-G kits before tackling H power and up. When you go for your NAR or TRA certification, choose a rocket where G and H motors are the low end or mid-range power options. Going with a rocket where your chosen motor is at the high end or above the rocket's recommended power range is more likely to fail by over-stressing the design. Bigger, slower high power rockets are less stressed and more likely to succeed. In the case of NAR certification, this gets you a rocket good for multiple certification levels. I like the following (any are good NAR or TRA certification rockets):

LOC Mini Magg, 38mm mount	(G-I motors)
LOC EZI-65, 54mm mount	(G-I motors)
THOY (Rocket R&D) Falcon, 54mm mount	(H-J motors)

From: mike_forman@cjnetworks.com (Mike Forman)
I bought, built, flew and certified on a PML Io. Very nice kit. I glassed the tube, and would bet it's as close to bulletproof as you could get and still be legal to fly as a hpr. I posted a review of the Io here, and you could probably go to dejanews' archive and retrieve it. Great rocket, great flights, easy to build.

From: marku@netins.net (Mark U.)
My favorite 4 in. rocket is the THOY/R&D Falcon. In stock configuration it easily will handle H-J and, if beefed up, a K is not out of the question. My second choice would be a PML Quasar this will fly nicely on a H-I motors.

10.11 When is a Federal Low Explosives Permit required?

NOTE: As of 1997, the BATF will be formally clarifying their interpretation of what high power rocket motors require a Federal Low Explosives Users Permit (LEUP). At the time that this is written (Jan. 9, 1997) it appears that reloadable motor propellant segments less than 62.5 grams in mass will require a LEUP if their intended use is to assemble a motor that has more than 62.5 grams of propellant. Furthermore, LEUP fees may be raised. At the time of this writing, these changes are not yet in effect. The National Association of Rocketry and Tripoli Rocketry Association are working together to see what can be done to protect the interests of high power rocketry enthusiasts, and will be keeping their members informed of the latest developments.

The following are excerpts from a joint communique issued by the High Power Rocket Manufacturers and Dealers Association and the Tripoli Rocketry Association to the high-power rocket community on 25 April 1994. It was posted to CompuServe by Michael Platt, president of the HPRMDA.

[Based on informal clarifications from the BATF, it is our belief that:]

(a) single-use model rocket motors containing no more than 62.5 grams of propellant are exempt from Federal licensing and storage requirements;

(b) reloadable rocket motor products are also exempt from Federal licensing and storage requirements, provided that the mass of each propellant grain is no more than 62.5 grams, and has received a DOT shipping designation as Explosive 1.4, but may not be made available to children;

(c) any single-use motor containing propellant mass greater than 62.5 grams, or any reloadable rocket motor product containing a propellant grain which weighs more than 62.5 grams, is subject to Federal licensing and storage requirements.

Users (e.g. consumers, flyers) of high-power rocket motors and reload kits as described in item (c) above, are subject to Federal, and possibly state and local, permit requirements for the purchase and storage of explosives. On the Federal level, this involves obtaining an explosive user permit from BATF, at a cost of $20 for the first year, and $10 for each subsequent three-year period. An important exception to the Federal requirement for a user permit is if the user were to purchase a motor or reload kit in his state of residence as defined by BATF, and either (a) use the motor or reload kit at the site of purchase (e.g. a launch), or (b) transport it to an approved storage facility located within the boundaries of said state.

Everyone--manufacturers, dealers (distributors), users--who stores (as defined by the BATF) a high-power rocket motor or reload kit as described in item (c) above is subject to Federal, and possibly state and local, requirements for the storage of explosives. All storage of a high-power rocket motor or reload kit must be in accordance with Federal explosive storage requirements, even if a Federal license/permit is not required for purchase. There are no exceptions to this rule.

A document with questions and answers about the BATF and rocketry is available at the sunsite archive:

http://sunsite.unc.edu/pub/archives/rec.models.rockets/BATF/batfqa.txt

Instructions for filling out a LEUP are available on the Rocket Science web site:

http://www.scsn.net/users/rockets/LEUP_consumer.html

10.12 How do I get an LEUP? Are there any requirements?

The following is an excerpt from the June 1994 'Tripoli Report'. Since

this deals with Federal Law and not Tripoli rules, I do not believe that there is any violation of Tripoli by-laws in doing this.

Q: How would a person qualify for a Federal user's permit?
A: The chief, firearms and explosives licensing center, will approve a properly completed application if the applicant:

1) Is 21 years of age or older,
2) Is not a person to whom distribution of an affected high-power rocket commodity is prohibited under the Act (Federal law),
3) Has not willfully violated any provisions of the Act,
4) Has not knowingly withheld any information or has not made any false or ficticious statement intended or likely to deceive concerning the application,
5) Has storage for the class (low explosive) of an affected high-power rocket commodity, as describedon the application, unless he establishes that his operations to be conducted will not require the storage of an affected high-power rocket commodity.
6) Is familiar with and understands all published state laws and local ordinances relating to affected high-power rocket communications in which he intends to conduct operations.

ATF Form 5400.13/5400.16 must be filed to obtain a permit.

From: bmcdermo@ix.netcom.com (Buzz McDermott)
You may obtain a users permit with or without a storage magazine. If your primary reason for the permit is to be able to buy HPR motors at out of state launches, then you don't need a home storage magazine. If you do have a home storage magazine, remember to keep the proper records for all motors added to and removed from the magazine.

Michael Platt has indicated willingness to help anyone who has any questions regarding the proper filling out of the permits. He may be reached at 70233.255@CompuServe.COM.

10.13 How is thermalite affected by the ATF regulatory enforcement?

From: 70233.255@CompuServe.COM (Michael Platt)
Thermalite is a brand name for igniter cord. Purchase and storage of igniter cord is regulated by BATF. Purchase and/or storage of igniter cord, IN ANY QUANTITY, requires an explosive license and an approved storage facility, i.e. an explosive magazine. This includes thermalite in any length, including the one inch lengths commonly included with motors produced by various manufacturers. The only exception to this would be the purchase by a user for immediate use in the state where he/she resides.

10.14 How can I get the Orange Book (explaining the ATF explosive laws and regulations) and the proper LEUP forms?

Scanned copies of the BATF non-copyrighted book titled, "ATF - Explosived Law and Regulation," were generously provided by Tom Perigrin and Doug Caskey. See:

http://mercury.aichem.arizona.edu/~tip/legal/Orange.html
http://members.aol.com/RocketWeb/atf/orange.htm

Call your regional BATF office and ask for the Orange Book, and an application for a Federal Low Explosives Users Permit. Remember that you want a Users permit (there are several other types of permits). The regional office will mail these to you at no charge. The documentation you receive will indicate where the filled in forms and payment should be remitted.

10.15 Just what is a 'hybrid' rocket motor? Who makes them?

From: kevinr5053@aol.com (Kevin Reed)
A hybrid motor as sold for model rocketry uses a solid fuel grain and a liquid oxidizer -- in the case of commercial model motors, nitrous oxide. A composite motor uses a solid oxidizer -- ammonium perchlorate -- mixed with a rubber binder/fuel to make a unified solid grain.

I can't think of any 24mm hybrids on the market; the smallest, I think, has an "I" rating and fits into a 54mm mount.

There are two companies currently manufacturing them commercially, Aerotech and Hypertek. One system loads the oxidizer tank before loading the motor in the rocket, while the other fills the tank after the rocket is in launch position.

Hybrids have a couple of advantages over composites: one is that there is virtually no fire hazard transporting or storing the motor: without the oxidizer in direct contact with it, the fuel grain is almost inert. It is also not covered bythe same DOT shipping restrictions, because the tanks are DOT certified and the fuel grain poses no environmental or fire hazard.

[Editor's note: The Jan 1996 issue of High Power Rocketry magazine has an excellent article comparing the Hypertek and Aerotech hybrid systems.]

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